

A DISSERTATION ON  
**RECONSTRUCTIVE OPTIONS IN HEAD &  
NECK CANCER SURGERIES**

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## **BONAFIDE CERTIFICATE**

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## **INTRODUCTION**

Head & Neck cancer surgery entails a range of surgery from simple primary closure to complex reconstruction requiring free flaps. It is prudent to follow an order of reconstruction using the simplest that suits the requirement.

Excision of head and neck tumors may result in exposure of vital structures such as the brain, eye, aerodigestive tract or major neurovascular structures. If inadequately reconstructed, such defects may result in significant complications and/or impairment in the performance of routine daily functions, such as speech and swallowing. In addition, esthetic disfigurement may be very significant to the patient's self-image and social adaptability. Adequate reconstruction after tumor excision is therefore the first step to rehabilitating the head and neck cancer patient-aiming to preserve and restore preoperative activity and quality of life.

## **HISTORY**

Current treatment in head and neck cancer is based primarily on combined therapy, which includes radiation therapy, surgery and chemotherapy. Orthovoltage radiation therapy was the mainstay of head and neck cancer treatment until the 1940s. Advances in the field of anesthesia and new, safer techniques in surgery led to the current combination of therapy offered to

patients with cancer of the head and neck. The defects created with these advanced techniques at the time of surgery for head and neck cancer have led to advances in reconstruction. A brief history of these developments is provided below:

- Before 1963, oral and pharyngeal defects were closed primarily and reconstructed with random pattern skin flaps or tubed-pedicled flaps of skin from the trunk.
- In 1963, McGregor first described the forehead flap.
- In 1965, Bakamijan first described the deltopectoral flap.
- In 1979, Ariyan described the pedicled pectoralis major myocutaneous flap, which became the predominant method for reconstruction head and neck cancer.
- In the early 1980s, Demergasso, Piazza, Panje, and Baek described the trapezius flap and its modifications for head and neck reconstruction.
- Tansini first described the latissimus dorsi flap in 1896 as a method for chest wall reconstruction after mastectomy. Quillen and Shearin demonstrated the application in head and neck reconstruction.

- In 1973, Daniel and Taylor reported the first free flap, the transplant of an autologous skin flap to the lower extremity using the operating microscope.
- In 1976, Panje and Harashina simultaneously described the use of free flaps to reconstruct defects of the oral cavity.
- In the late 1980s and early 1990s, the use of osteocutaneous free flaps to reconstruct mandibular defects and advanced.

## **Reconstructive principles**

### **Immediate reconstruction**

Ideally, reconstruction of a surgical defect should be performed immediately-at the time of tumor resection. Immediate reconstruction prevents retraction and fibrosis of the defect, allows administration of adjuvant therapy, minimizes the number of surgical procedures and favors psychological rehabilitation. With development of better diagnostic techniques (i.e. CT scan, MRI, PET etc), delayed reconstruction to detect tumor recurrence earlier is no longer valid. Likewise, it is not acceptable to favor delayed reconstruction, arguing better appreciation of the oncologic defect by the patient.

**Restoration of form and function**

The basic tenets of reconstructive surgery include restoration of form and function while minimizing donor site deformity. Whenever possible, this should be accomplished with similar tissue rather than allografts or synthetic materials. An additional principle in head and neck reconstruction is to respect facial esthetic units or subunits by placing scars following a crease or transition skin in the face.

**Reconstructive Ladder**

Surgical options for head and neck reconstruction have been described schematically as a ladder; starting from direct closure and skin grafting and moving forward to local flaps, regional cutaneous and myocutaneous pedicled flaps, and finally to the wide variety of microvascular free flaps. Historically, it has been recommended to start from the simplest method and if required or the first option fails, to move over to the next step on the reconstructive ladder. Restoration of form and function are the twin objectives of head and neck cancer reconstruction.

To achieve these twin objectives, the best method suited to the requirement is chosen, not necessarily along the ladder. Surgeons must realize however that they are not obligated to push their patients through all or most of these steps and that many times the concept of reconstructive elevator



advancing directly to microsurgical technique is most appropriate. Microvascular free flap technique was not used in our department. The other methods have been used according to the requirement.

The current approach, hence, is to select the reconstructive option which best provides the patient with the ideal reconstruction, thus maximizing functional and esthetic results primarily. For example, a young, healthy patient with a mandibular defect is best reconstructed using an osteocutaneous free flap at the time of tumor resection, instead of using a reconstruction plate covered with a pedicled myocutaneous flap.

In selecting the best option for reconstruction of head and neck defects, these basic principles should always be followed for a successful outcome. In addition, other issues such as age, functional status, concomitant medical conditions and extent of disease must be taken into account.

#### **No closure** (Healing by secondary intention)

In certain areas like floor of mouth, tongue small defects can be left to heal by secondary intention without producing any deformity or disability.

**Primary Closure**

This is the simplest method of reconstruction and should be the preferred one when feasible. Wound healing is good and without much complications.

The skin in the face and neck is very elastic and its laxity allows extensive undermining and direct closure, particularly in elderly patients. In order to minimize the visible scar, the excision should be designed to fall within the relaxed skin tension lines. Wherever possible, primary closure should be used for repair of defects of the eyelids and lips. Up to one-third of the eyelid and lip can be resected in a V fashion, with primary closure.

These critical areas are difficult to reconstruct using distant tissue that is different both structurally and functionally. Most neck dissection incisions, small defects in areas of loose skin, Thyroid incisions and hemiglossectomies can be closed primarily.

**Skin graft****Split skin graft**

SSG can be used in certain areas to hasten healing and early restoration of function. Skin grafts have also been used to resurface intraoral defects confined to the floor of the mouth, lateral aspect of the tongue, retro molar

trigone or cheek mucosa.

Due to unpredictable scarring and contraction of skin grafts used intraorally, it is imperative that such defects be limited to achieve the best results. In our series small defects in buccal mucosa, FOM, tongue, neck skin are situations where SSG has been used.

### **Full thickness skin graft**

Full-thickness skin grafts are suitable only for small defects because their donor sites must be closed primarily. Colour match and texture of full-thickness skin grafts is better. Within the head and neck, they are a good choice for resurfacing eyelids and small nasal skin defects. Usual donor sites for full-thickness skin grafts are the forehead, preauricular, post auricular, contra lateral eyelid and supraclavicular regions.

No full thickness skin graft has been used in our series.

### **FLAPS**

A flap is a full-thickness segment of tissue that has its own blood supply. Depending upon the type of tissue, these flaps can be cutaneous, fasciocutaneous, muscle, musculocutaneous, osseous or osteocutaneous. According to their location (donor site), flaps are classified as local, regional or distant. Selection of flaps;

The following aspects were considered when selecting the flap to be used.

- i) the site of resection
- ii) the extent of defect.
- ii) the types of tissues required like skin, soft tissues and bone.
- iv) The donor site characters
- v) The age and sex of patients
- vi) the reach of the flap
- vii. Previous Radiotherapy may preclude local flap use.

The simplest and the reliable flap is chosen. Sometimes more than one flap has been used to good effect in the same patient like (i) PMMC and deltopectoral flap

## **LOCAL FLAPS**

Local flaps consist of tissue that is mostly detached from surrounding tissue but retains enough connection to preserve an adequate blood supply to the entire flap. These are mostly cutaneous flaps that are used very often for reconstruction of small-to moderate-sized cutaneous defects of the head and neck. Local flaps may be transposed, rotated or advanced, and the donor site closed primarily. Examples of local flaps frequently used for reconstruction of facial defects include the Limberg or rhomboid (transposition), V-

Y(advancement)and Imre(rotation)flap. Rearrangement of existing tissue in one area (i.e., Z-plasty) is another technique frequently used to change the orientation of a scar or lengthen a scar contracture.

Moderate-sized composite defects requiring specialized tissues, such as those of the eyelids or lips, can often be reconstructed using switch flaps from their opposite, intact counterparts. The borrowed tissue is mobilized and left attached to the defect for 3 weeks. At this time collateral neovascularization to the flap is developed at the recipient site, the original vascular pedicle is divided and both defects closed primarily.

### **Random flaps**

A random flap is a cutaneous flap (i.e. skin and subcutaneous tissue) that receives its blood supply through the subdermal capillary plexus rather than from named vessels. Random flaps for head and neck reconstruction are transposition, rotation or advancement flaps that are used mostly to resurface superficial defects after excision of skin cancers. its length-to-width ratio should be no larger than 3 to 1 so that the entire flap can survive. Occasionally, the flap vascularity may be augmented using a so-called delay procedure, which consists of partially raising the skin flap and suturing it back to its vascular bed for 2 to 3 weeks. Tissue expansion has been extremely useful for head and neck reconstruction achieved in a delayed fashion.

**Nasolabial flaps**

The skin parallel to the nasolabial fold can be raised as an axial cutaneous flap. Depending upon flap design (either superiorly-or inferiorly-based), the blood supply is provided by branches of the facial, infraorbital and angular vessels. Superiorly based nasolabial flaps are more useful for reconstruction of small-sized nasal defects, due to easier due to transposition. The inferiorly-based pedicle flap is often advanced in a V-Y fashion for cheek or upper lip defects. Nasolabial flaps are usually elevated in a superficial subcutaneous plane that excludes the main vascular pedicle. The donor site is usually closed primarily, with the scar concealed within the skin fold. Sometimes a secondary revision may be needed. Bilateral nasolabial flaps, based on the facial artery and vein, have been used to resurface floor of mouth and intraoral defects.

Cervicofacial, nasolabial, tongue flaps were the local flaps used in our series. They carry good cosmetic result with reliable vascularity.

**Forehead flap**

The forehead flap is based on the axial blood supply and was originally described by McGregor in 1963. It gives reliable tissue cover for moderate sized, defects within its reach. Usually used for full thickness buccal defect in our series.

**Advantages:**

Good vascularity, pliable, thin flap

**Disadvantages:**

Requires flap revision & SSG for donor site.

Donor site morbidity in the form of poor cosmesis.

**Regional flaps:****Deltopectoral Flap**

The Deltopectoral flap was the workhorse for intraoral, cheek and neck reconstruction in the 1960s and 1970s. Bakamjian described this flap in 1965. The flap is based on the first, second and third perforators of the internal mammary artery and associated venae comitantes. The base of the flap is located at 2cm from the sternal edge, where the perforators pierce. Cranial incision follows the infraclavicular line and the caudal incision parallels the cranial incision. The flap extends to the shoulder or even the upper arm. However, depending upon the size of the flap needed, one or more delays may be required prior to transfer.

The deltopectoral flap has been used to resurface defects of the neck, face and oral cavity.

It is a fasciocutaneous flap with excellent vascularity, if confined to its standard extent of upto the acromion laterally. It can reach upto zygoma.

Advantages;

Thin pliable flap

Reliable vascularity.

Disadvantages;

Needs flap revision

The donor site must be skin grafted, resulting in a significant disfigurement

Patient has to be in head tilt/flexion position for the entire postoperative period till flap revision usually after 3weeks

Pedicle exposed to environment.

Requires delay if extended flap into be raised.

In our series it has been used to cover cheek, neck defects

**Myocutaneous flaps:**

Myocutaneous flaps revolutionized head and neck reconstruction in the 1970s. The pectoralis major myocutaneous flap rapidly become the workhorse for reconstruction of intraoral and cheek defects and for covering synthetic materials used for mandible reconstruction. Other myocutaneous pedicled flaps



used less often for reconstruction of posterior or lateral defects in the head and neck region include the temporalis muscle, latissimus dorsi, trapezius, sternocleidomastoid and platysma muscles. Although regional muscle and myocutaneous flaps are useful options for head and neck reconstruction, they often cannot reach the defect due to a limited arc of rotation (imposed by the vascular pedicle), and may result in incomplete survival of the skin island. In addition, donor sites are very noticeable, particularly when skin grafting of the defect is required.

### **Pectoralis Major Flap**

The pectoralis major myocutaneous flap is the most frequently used pedicled flap for head neck reconstruction. Originally described by Ariyan in 1979 this flap still enjoys the overwhelming patronage of head and neck surgeons. The PM muscle originates from the clavicle, the first five ribs, the xiphoid, and from the upper abdominal muscles. It inserts into the humerus. Its blood supply is provided by branches of the thoracoacromial trunk, which pierces the clavipectoral fascia medial to the tendon of the pectoralis minor muscle. Multiple perforators run through the muscle in the subcutaneous fat, supplying the overlying skin with direct cutaneous vessels. The skin paddle can be located anywhere over the muscle pedicle. However, the design used most often is a vertical paddle up to 8x17cm raised over the sternal origin of the muscle, which provides thin skin and allows primary closure of the donor defect. The skin island may extend into the inframammary fold and multiple

skin paddles can be carried on the same muscle pedicle. The PM flap has been used to resurface cervical, facial, intraoral and pharyngeal defects. Although it can reach as far as zygoma, the most distal part of the flap may be compromised due to limited arc of rotation. In addition, it is often too bulky for intraoral reconstruction where thin, pliable tissue is needed to replace intraoral lining. The donor site may be closed primarily; however, a very noticeable scar and nipple-areola distortion is often observed. Large or multiple skin islands may result in the need for donor site skin grafting.

The incidence of total flap necrosis has been reported as 1 to 3 %. The incidence partial flap necrosis is as high as 30 % in some series is probably related to the degree of caudal extension of the skin paddle over the rectus sheathe.

The pectoralis flap may be less reliable for more cephalic defects of the face, scalp and pharynx. Further more the effect of gravity on the bulky PMMC flap may be detrimental, especially when the flap is placed in an unfavourable recipient bed or when a patient is at risk for compromised wound healing.

It is the predominant flap used in our series to line intraoral, pharyngeal defects to cover cheek, neck skin defects or to act as lining and cover by bipaddling

Advantages;

Reliable

Easy to raise; technically less demanding

Provides adequate soft tissue cover to carotids

Provides soft tissue bulk as well as skin

Donor site can be closed primarily.

Cosmetically acceptable

Disadvantages.

Bulky in females and obese males.

Hair growth inside oral cavity in hirsute persons

In our department, the following technical details are followed

- i) Placement of the paddle inferomedial to the nipple usually in a horizontal manner.
- ii) Shape and size according to the requirement
- iii) Subcuticular anchoring of the muscle fascia to prevent shearing of subdermal vessels.
- iv) Taking the muscle to a greater extent than the skin paddle.

- v) Dividing the lateral pedicle to improve arc of rotation

### **Latissimus Dorsi Flap**

This is another reliable flap with large skin area available and a reach of upto scalp. This is the first myocutaneous flap to be described in the medical literature (Tanzini, 1896). When all pedicled myocutaneous flaps are considered, the latissimus dorsi has the largest potential skin area (25 x 40 cm) available for transfer to the head and neck.

The latissimus dorsi muscle originates from the six caudal thoracic spines and fascia, the lumbar spines and fascia, and the posterior iliac crest. It inserts into the humerus. Its blood supply is from the thoracodorsal artery, accompanied by the thoracodorsal vein and nerve. The neurovascular pedicle enters the undersurface of the muscle 6 to 11.5 cm distal to the origin of the subscapular artery and 1.0 to 4.0 cm medial to the anterior border of the muscle. The thoracodorsal artery divides into a medial and lateral branch. The medial branch parallels the upper border and the lateral runs 2.5 cm from the lateral edge of the LD.

Advantages:

1. Reliable blood supply
2. large skin area

3. multiple skin paddles may be designed
4. longest reach of all pedicled flaps
5. Functional disability that results from the transfer of the latissimus dorsi muscle is reportedly less than either pectoralis muscle or trapezius muscle
6. In Young females cosmetically more acceptable.

Disadvantages:

1. Repositioning of the patient is required during surgery.
2. Large defects in the donor area will need skin grafting

It has been used in our series in situations where PMMC has failed or when large skin paddle is required.

**Free flaps:**

Perhaps the most significant contribution to management of head & neck cancer patients in the past 3 decades is the development of microsurgical free tissue transfer. Success rates using microvascular reconstruction have been reported to be > 95 % in most major centres. Only 4 free flaps are commonly required for reconstructing 95 % of head & neck defects. These include radial forearm free flap, rectus abdominis, fibula and jejunum.

### **Radial forearm free flap**

RFFF is a fasciocutaneous free flap, based on the radial artery and cephalic vein. It consists of thin pliable skin with minimal soft tissue and a very long pedicle of large diameter. In addition sensory nerve can be included to provide sensation at recipient site. These characters have made it an useful flap for intraoral, pharyngeal and cutaneous facial defects. It can be designed to include tendons, muscle or a vascularized segment of bone upto 12 cm in length for reconstruction of total lower lip, cheek, maxillary & mandibular defects.

### **Rectus abdominis muscle:**

It is a flat and thin muscle with a large skin island over the muscle that may be oriented in a vertical or transverse fashion. One or more cutaneous paddles may be used to cover multiple complex defects. The pedicle is deep inferior epigastric artery and vein which are of large caliber and length. No repositioning of patient is required so that simultaneous harvesting is possible.

### **Fibula:**

Since introduced first for mandible reconstruction in 1989, the fibula free flap has been used to reconstruct challenging defects in head and neck. Approximately 22 to 25 cm of bone can be harvested. This thick cortical long bone receives its endosteal and periosteal blood supply from the peroneal artery

and veins. The excellent periosteal blood supply allows multiple osteotomies. The identification and inclusion of one single septocutaneous perforator can adequately perfuse a skin island of 10 x 22 cm. This may be used to reconstruct oromandibular defects including skin and lining.

### **Jejunum:**

This was the first microsurgical flap reported in the literature. Currently the jejunal free flap is used as a mucosal tube or patch for reconstruction of the hypopharynx or cervical esophagus.

Advantages:

1. No limitations of reach
2. Reliable blood supply
3. No need for extensive thoracic or abdominal dissections
4. Postoperative RT can be given.

### **Major oropharyngeal resection**

The composite resections, pharyngolaryngectomy and pharyngolaryngoesophagectomy require complex reconstruction with various types of tissue requirement.

The various pedicled flaps mentioned earlier were used to provide

adequate soft tissues. Skin cover and lining with acceptable results. PMMC has been used to restore defects caused by pharyngolaryngectomy Restoration of gastrointestinal continuity can be achieved by many methods like free jejunal transposition, gastric pull up or colonic transposition.

### **Gastric transposition :**

Ong and Lee reported the first cases of pharyngogastric anastomosis in 1960. Gastric pull up has been the method of choice in our series for pharyngolaryngoesophagectomy.

#### **Advantages:**

1. one stage reconstruction with a single enteric anastomosis
2. extremely reliable with an incidence of organ necrosis of only 3 %
3. overall success rate for swallowing exceeds 80%
4. oral alimentation is established in 7 to 12 days

#### **Disadvantage :**

Postoperative irradiation cannot be given as stomach tolerates RT poorly.



## **Bone reconstruction;**

### **Mandible :**

The mandible is essential to maintain adequate mastication, deglutition and speech. Functional deficits after mandibulectomy depend upon the extent and location of the resection lateral segmental defects are less likely to cause functional deficit if dental alignment can be maintained. Anterior defects must be reconstructed because of severe functional problems.

Options for mandible reconstruction:

1. Nonvascularized bone grafts
2. Reconstruction plates with or without soft tissue pedicled flaps
- 3 . Vascularized osteocutaneous flaps

Mandibular resections offer the most technically challenging situations as no effective replacement is available in our setup in the absence of free flaps and alloplastic implants.

Most hemi mandibulectomies were done with a paramedianmandibulotomy at the incisor level.

These bony defects were remarkably well accepted by the patients even if not reconstructed.

More anterior resection involving mentum proved technically challenging for reconstruction with the available resources.

Mandibular reconstruction plates were used with futility as invariably the metal plates were extruded in the postoperative period due to infection or/and loss of soft tissue cover.

### **Maxilla :**

Maxillary defects have been comparatively easier managed by the use of prosthesis and obturators for palatal defects. Even though the obturators used were temporary, patients have been referred to dental hospital for effective obturators with dentures.

### **Prosthetic restoration**

Restoration of the facial defect is a difficult challenge for both the surgeon and the maxillofacial prosthodontist. It is not uncommon for an advanced head and neck cancer to require a rhinectomy, orbital exenteration, loss of an ear or cheek, or a midface resection (nose, lip, palate). Both surgical reconstruction and prosthetic restoration have distinct limitations.

The choice between surgical reconstruction and prosthetic reconstruction and prosthetic restoration of large facial defects is difficult and complex and depends on the size and etiology of the defect and on the patient's desires.

Surgical reconstruction of small facial defects is possible in most cases - and preferable. Many patients prefer masking a defect with their own tissue rather than with a prosthesis. It is difficult (if not impossible for the surgeon to fabricate a facial part that is as successful in appearance as a well-made prosthesis. However, not everyone will accept an artificial part, and many would rather have a permanent, though perhaps less esthetic, nose or ear.

### **Anterior cranio facial resections**

Craniofacial resections are done in tumors extending to the skull base without intradural extension. They require meticulous repair of the base of skull to achieve watertight closure to prevent CSF leak in the postoperative period.

Two anterior cranio facial resections were done in study period. Both the patients had excellent recovery and rehabilitation. Strict adherence to the following principles had produced such result

- I) Good oncological resection.
- ii) Hypotension of the intracranial pressure (brain calming)
- iii) Strict asepsis.
- iv) Tight cranionasal separation by the use of pericranial / dural flaps and subcutaneous augmentation material. Pericranial flap alone can be used for the reconstruction of small to medium sized defects of the floor of anterior cranial fossa.
- v) meticulous postoperative care.

## LITERATURE REVIEW

### Literature review

1. **Milenovic A. *et al.***, in their series, reportedly the largest on PMMC in head and neck reconstruction, of 506 flaps had the following results; The tumours were intraoral in 387 cases (77%), pharyngeal in 78 cases (15%) and on the skin in 10 cases (5%). The defect was located in the **mucosal lining** in 407 (81%), **skin** in 43 (8%), **both intra- and extraoral** in 53 (10%) patients. Bone defects occurred in 65 patients. In 31 patients (6%), the pectoralis major flap was used in combination with other flaps (deltopectoral, tongue, trapezius and free laps). **Complications** occurred with 168 flaps (**33%**), but **total flap necrosis** was only seen in 10 patients (**2%**). Surgical treatment of complications was necessary in 87 patients (17%).

They concluded that despite the increasing use of microvascular reconstruction, the pectoralis major myocutaneous flap continues to be the most universal major flap in head and neck reconstruction

2. **Wadwangtham** et al reported their experience with 96 cases of PMMC flap repair in 2004. The utilization of the

pectoralis major myocutaneous flap included 50 tongue replacements, 19 hypopharynx and pharyngoesophageal closure, 11 oral mucosal closure and external skin replacement, 7 soft tissue coverage of the reconstruction plate, 3 soft tissue protection of the great vessels at the neck and 6 correction of the wound breakdown from failure of the other flap reconstruction. The **major complication**, which included total flap loss, partial skin paddle loss, orocutaneous fistula, dehiscence and plate exposure, was **17.7%**. The **overall complication** rate was **54.2%** and most of them were healed by conservative management.

3. **Ahmad OG. *et al.***, in their series of 47 patients of bipaddled PMMC reported a complication rate of 30 % and a total flap necrosis rate of 2.12 %. They concluded this technique is a useful alternative where microsurgical free tissue transfer is not possible or as a salvage procedure in selected large full thickness oral cavity lesions.
4. **JJ Coleman *et al.***, reported their experience of pharyngeal reconstruction with PMMC. They had a success rate of 42 % in 24 patients as compared to 63 % in 70 patients with jejunal free flaps

5. **Koh K S** et al. reported their series of oropharyngeal reconstruction with PMMC and free flaps. The authors reviewed 34 pectoralis major musculocutaneous flap cases and 18 free flap cases (12 radial forearm flaps, six rectus abdominis flaps) involving oropharyngeal reconstruction. In pectoralis major musculocutaneous cases, all defects were reconstructed successfully, with only two cases of partial necrosis that were managed conservatively. Among the free flaps, two resulted in total flap loss and were subsequently replaced with pectoralis major musculocutaneous flaps. Fistula formation did not occur in any case in either group. They concluded that the free flap is an excellent method for oropharyngeal reconstruction, but the refined pectoralis major musculocutaneous flap can also produce acceptable results with minimal complications.
  
6. **P. Chaturvedi** *et al.*, argue for the use of pedicled flaps in developing countries like India. In a defect that requires a large skin and mucosal lining the authors routinely use either a bi-paddle PMMC or a combination of PMMC (for the mucosal lining) and a delto-pectoral flap (for the skin defect). It is indisputable that free tissue transfer is a better way of reconstruction for the majority of most such defects. Unfortunately, not all patients can be offered this form of

reconstruction due to the cost, time, expertise and infrastructural constraints in high volume centres

### **Deltpectoral flap**

7. **Feng GM** et al . report their experience with DP flap:

34 patients required reconstruction of the head and neck using this flap. Twenty-nine had had one or more failed attempts at microsurgical reconstruction after excision of cancer. Five were treated primarily. The flap was divided at least three weeks after the primary operation. All 34 survived, and there were no donor site complications. Twenty-seven patients had an uncomplicated outcome, but the remaining seven required later closure or skin grafting, usually under local anaesthesia, for complications

They conclude that the extended deltopectoral flap should remain in the armamentarium of reconstructive surgeon

8. **Fitschberger E. et al** reported their experience with various reconstruction methods for head & neck. A total of 165 patients, operated upon between 1973 and 1980, has been reviewed Their split up of cases included 51 forehead flaps, 8 DP, 42 tongue, 7 myocutaneous, 8 others and 41 primary closures.



They scale the methods according to clinical value as follows:

The pectoralis major myocutaneous island flap and the tongue flap equally range on the first place, followed by the myocutaneous sternocleidomastoideus island flap, and on the 3. and 4. place by the deltopectoral and forehead flap

9. **Issing PR *et al.***, reported their experience with various techniques in 107 patients. The pedicled myocutaneous pectoralis-major- and latissimus-dorsi-flaps were used for reconstruction (n = 67), but the arc of rotation and the huge bulk of the graft are limiting factors for the indication of these techniques. The free forearm flap has increasingly been used to provide an excellent closure of large pharyngeal defects (n = 16), whereas the temporalis flap is useful for restoration after limited resection of the palate (n = 18).

They conclude that the potential of modern regional reconstructive surgery enables the surgeon to achieve anatomically and functionally rehabilitation in a one-step procedure in most cases, even after extended resection for head and neck cancer.

### **Tongue flap**

10. **Desanto LW *et al.***, report their experience of over 100 tongue flaps. The tongue flap still retains its initial advantages of providing tissue bulk and volume, dependable vascularity, and considerable versatility in design and application.

### **Mandibular reconstruction:**

11. **Okura M. *et al.***, reported their experience in mandibular reconstruction using bridging plate in 100 cases. The plate survival with no complications was 62.2% at 5 years. Anterolateral defects and preoperative radiotherapy emerged as an independent adverse factor for plate survival.

### **Gastric pull up :**

12. **Jean-pierre Tribaulet M.D. *et al*** reported their series of 209 cases of hypopharyngeal reconstruction with various methods.

Three different operative procedures were performed in this study: 127 patients (61%) had pharyngolaryngectomy and total esophagectomy with pharyngogastric anastomoses; 77 patients (37%) had pharyngolaryngectomy and cervical esophagectomy, and reconstruction with free jejunal transplant; and 5 patients (2%) had pharyngolaryngectomy and total esophagectomy with pharyngocolic anastomoses

Necrosis and fistula rates for free jejunal transfer (7% and 31%, respectively) are significantly higher than for gastric interposition ( $P = .01$ ).

13. **Marriette C. *et al.***, reported their experience in pharyngolaryngectomy in 209 cases. Alimentary continuity was achieved using the stomach (127 patients), colon (5 patients), or free jejunal autograft (77 patients). There was no significant difference with regard to the survival between gastric transposition and free jejunal autograft, they concluded that Surgical ablation is a viable option for advanced hypopharyngeal and cervical oesophageal neoplasms, and stomach interposition is the preferred method of reconstruction.
14. **De vries EJ *et al*** reported their experience in 31 cases of hypopharyngeal reconstruction using gastric interposition and free jejunal flap. Complications and functional outcomes of the two methods are compared. Primary swallowing was achieved in 86% of patients after gastric pull-up and in 82% of patients after jejunal interposition. Patients who underwent jejunal interposition were able to swallow sooner and had a shorter hospital stay than patients who underwent gastric pull-up.

## AIM

The study aims to analyze the various reconstruction methods used in the head & neck cancer surgery at the **surgical oncology** department of **Government Royapettah hospital** in the study period of August 2004 – April 2007.

All head and neck surgeries from the simplest skin cancer excision to the complex oropharyngeal resections were to be analysed as to

1. The reconstruction requirements of the various head and neck cancer resections
2. The types of reconstruction methods used
3. The complications associated with each of them
4. The final outcome associated with major oral resections and their reconstruction.

## **MATERIALS AND METHODS**

All the patients who had head and neck cancer surgeries between August '04 and April ' 07 were included in the study.

A total of 180 surgeries were done for various cancers of the head and neck using various reconstruction options like primary closure, local flaps, regional flaps etc. Some patients had more than one type of reconstruction in the same or subsequent surgery.

A common proforma incorporating the details like name, age, sex, diagnosis, comorbid conditions, preoperative radiotherapy, extent of defect, the type of reconstruction used, postoperative complications and the functional outcome in the immediate postoperative period, 1 month after surgery and at 6 months were noted in all cases involving major oral cavity resections as applicable

The surgeries were analysed as to the outcome of each method.

## RESULTS

Of the 180 surgeries for head & neck cancers, **primary closure** was done in 79 cases.

Other reconstruction options used were as follows:

**Pedicled regional flaps** – 75

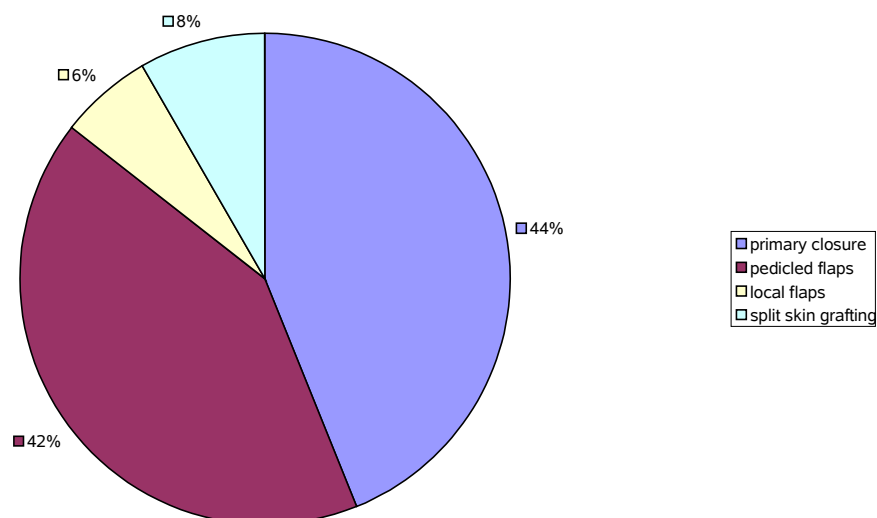
**Local flaps** – 11

**Split skin grafting** – 15

**No free flaps** were used in our series.

All reconstructions with the exception of one DP flap were done **without any expert plastic surgical help**.

### Types of reconstructions used



### **Disease patterns and the types of resections:**

The surgeries were done for the following types of cancers:

Thyroid, neck dissection

Cancers like lip, tongue, buccal mucosa requiring minor oral resections

Oral cavity cancers requiring extensive oral resections like composite resection.

Salivary gland tumors

Skin cancers

Oropharyngeal tumors

Hypopharyngeal cancers

Tumors involving the base of skull requiring anterior craniofacial

### **Resection**

Others

The following were the type of flaps used in the reconstruction:

PMMC pedicled flap

Forehead pedicled flap

Nasolabial flap

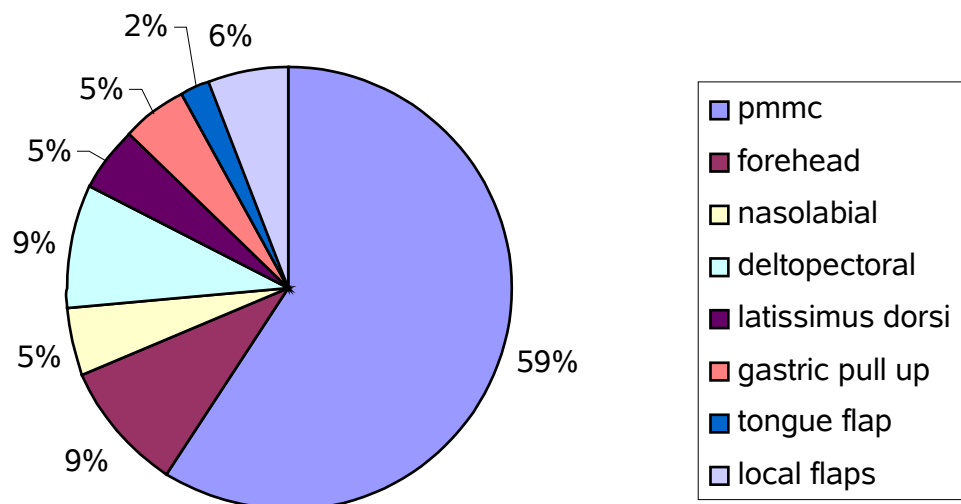
Deltpectoral flap

Latissimus dorsi pedicled flap

Gastric transposition

Local flaps including tongue flap

**various flaps used**





### Postoperative complications:

The immediate postoperative complications encountered among the various types of reconstruction were as follows

*Table 1 : Significant postoperative complications*

<b>Reconstruction</b>	<b>Gross infection</b>	<b>Partial necrosis</b>	<b>Complete necrosis</b>	<b>Dehiscence</b>	<b>Sinus fistula</b>
PMMC ( 50 )	7	17	-	17	17
Forehead (8 )	1	2	-	-	1
Nasolabial (4)	-	-	-	-	-
Latissimus dorsi ( 4 )	-	1	1	1	1
Deltpectoral(8)	-	-	-	-	-
Pericranial (2 )	-	-	-	-	-
Local (5)	-	-	1	-	-
Stomach ( 4 )	-	-	-	1	1
SSG ( 15 )	-	3	3	-	-
Primary closure( 78 )	2	2	-	8	1

### **Primary closures**

Of the 79 primary closures, 2 cases of infection, 2 partial necrosis (neck skin & tongue), 8 cases of minor wound dehiscence, 2 cases of fistulae of which one was chylous were noted.

### **Split skin graft:**

There were 15 cases of SSG, 3 patients each had partial and complete necrosis.

### **Local flaps**

The local flaps used included cervicofacial, nasolabial, tongue flaps and limberg flaps. Of the 11 local flaps, 1 gross infection, 4 partial necrosis, 1 dehiscence and 1 fistula were noted.

### **Forehead flaps:**

Forehead flaps were used for both lining and cover of full thickness cheek defects in all 8 cases. Of these 1 gross infection, 2 partial necrosis and 1 fistula were the complications.

### **PMMC flap:**

Of the 50 flaps, 29 were for lining the oral/oropharyngeal cavities, 6 were for cover the skin defects and 15 were for both lining and cover.

The incidence of various complications is as follows:

Gross infection (7), partial necrosis (17), dehiscence (17), fistula /sinus (17).

4 cases of secondary haemorrhage were encountered from carotid blowout.

The following factors were tested for their possible adverse effect on the flap viz. necrosis:

age more than 60 yrs

male sex

diabetes mellitus

Preoperative radiotherapy

Palatoalveolar resections

Bipaddled flaps

**Table showing the frequency of various factors in PMMC (n=50)**

<b>Necrosis</b>	<b>Age &gt;60</b>	<b>Male</b>	<b>DM</b>	<b>RT</b>	<b>Palatoalveolarresection</b>	<b>Bipaddled</b>
Yes	6	14	6	12	3	8
No	7	26	8	20	4	5
<b>P value</b>	0.375	0.768	0.528	0.768	0.683	<b>0.0257</b>

The chi square test and the Pearsons formula were used to assess the association between the above factors and flap necrosis and the p value arrived at.

Only **bipaddled flaps**, indicating the large size of flap, is a statistically significant adverse factor

### Comparison of our series with others

Authors	Type of flap	No of cases	Major complication	Overall complication
Ahmad et al, Tata memorial Hospital , Mumbai	PMMC	47	2.1 % complete loss	30 %
Wadwongtham et al Bangkok.	PMMC	93	17.7 %	54.2 %
Milenovic A. Zagreb, Croatia	PMMC	506	17 %	33 %
Koh K.S. et al Seoul	PMMC	34	6 %	Not mentioned
Feng G. M. Taiwan	DP	34	Nil	7 %
<b>GRH ,Royapettah, Chennai</b>	PMMC	50	31%*	52 %
<b>GRH ,Royapettah, Chennai</b>	DP	8	Nil	Nil

\*These included all partial necrosis, wound dehiscence and fistula cases. Only 8% required surgical intervention like re-suturing

### Latissimus dorsi flap:

Among the 4 flaps used, 1 partial, 1 complete necrosis, 1 dehiscence and 1 fistula were noted, with more than 1 complication in a case.

### Gastric transposition:

Of the 4 cases, 1 fistula, 1 dehiscence and 1 secondary haemorrhage were noted.

**Deltopectoral flaps :**

All the 8 cases were without any complication

**Pericranial flaps:**

Both the cases were free of any complication.

**Mandibular reconstruction :**

One patient had bone reconstruction in the form of stainless steel plate for central segment defect for a post RT ca FOM. Plate had to be removed due to flap necrosis and plate extrusion in the immediate postoperative period.

**Functional assessment :**

A scoring system devised by our department called the **Royapettah Scoring System** (RSS) to assess the postoperative outcome of our major oral resections incorporating both functional (chewing, speech, swallowing) and cosmetic aspects has been applied to all cases and the outcome assessed. A score of 17 or more was deemed a satisfactory outcome.

The association of the following factors with the functional outcome was assessed using the Chi square test.

<b>RSS 17 &amp; above</b>	<b>Age &gt;60</b>	<b>Male</b>	<b>DM</b>	<b>RT</b>	<b>Palatoalveolarresection</b>	<b>bipaddling</b>
Yes	8	28	6	21	6	10
No	5	12	8	11	1	1
<b>P value</b>	0.328	0.528	<b>0.004</b>	0.180	0.383	0.645

Only diabetes mellitus was associated with the outcome measure in a statistically significant manner (p =.004 )

## DISCUSSION

Head and neck reconstruction is a challenging task for the surgical oncologist and ranges from the simplest of primary closure to the complex microvascular surgical techniques.

In our department all the cases were reconstructed without expert plastic surgical help.

No free flaps were used in our series.

### **Primary closure**

Primary closure was done for all neck access incisions for neck dissections, thyroidectomies ,most hemiglossectomies ,minor skin defects.

Very few partial flap necrosis were seen and these were mainly due to technical reasons like thin flaps.

One case of flap necrosis of neck skin due to chyle fistula following thoracic duct injury during neck dissection required major intervention in the form of DP flap cover. Other cases were conservatively managed

One patient developed pharyngocutaneous fistula following laryngectomy and was managed conservatively.



### **Split skin graft**

15 skin/ mucosal defects were closed with SSG. Small mucosal defects of after resection of buccal, tongue and FOM ca were reconstructed with SSG. 3 cases had partial necrosis and 3 cases had complete necrosis.

### **Local flaps:**

Among the 4 nasolabial flaps all were for skin cancers. No complications were met with.

2 tongue flaps were used, one each for defects of FOM and lower alveolus defects. Both were posteriorly based and both healed without any significant morbidity.

5 local rotation flaps were used for skin cancer and parotid defects. 1 patient had partial necrosis salvaged by SSG.

### **Forehead flap**

The forehead flap has been routinely used for closing full thickness cheek defects of the 8 cases, 2 had partial necrosis and 1 had fistula.

### **Deltpectoral flap**

Deltpectoral flaps were used in 8 cases mostly to provide skin cover. In 2 cases, DP was used in conjunction with PMMC.

In 2 cases, DP was used for parotid region

1 case each for skin defects in the neck following submandibular tumor resection and flap necrosis complicating chylous fistula.

No postoperative complications were encountered in any of the flaps.

### **PMMC flap**

In the absence of free flap technique, PMMC has been the workhorse in our department as has been in other series worldwide, especially third world countries.

Of the 50 flaps, 29 were for lining the oral/oropharyngeal cavities, 6 were for cover the skin defects and 15 were for both lining and cover by bipaddling the flap.

There were 7 cases of gross infection, 17 partial necrosis, 17 dehiscence & 17 fistula.

4 cases of secondary haemorrhage due to carotid blowout occurred leading to a major complication of 31 % and overall complication rate of 52 %

2 cases required major surgical intervention like LD flap. Others were managed conservatively.

Resections involving the upper alveolus produced more

dehiscence/partial necrosis probably due to the sagging of bulky flap by gravity and thin mucosa over the palatoalveolar region. In our experience with PMMC we have observed

1. PMMC is satisfactory to provide adequate reconstruction without bony support.even when hemimandible is removed
2. PMMC is reliable, quick and easy to raise without much technical expertise
3. PMMC is unsatisfactory in short chested, obese patients and in females.
4. Bipaddling, thereby implicating large flaps, lead to greater flap necroses.
5. PMMC had to be in all irradiated cases because irradiation precludes the use of local flaps.

### **LD flap:**

Event though popular for its reliable pedicle and large skin area available, this flap has been used sparingly in our department mainly due to the need for repositioning the patient after resection.

Of the 4 cases reconstructed, 2 had no complications.

1 patient had to be taken up for LD flap as PMMC flap raising had to be abandoned midway because of inanition and poor pectoralis major muscle bulk. This flap was partially necrosed and fistula formed.

1 patient had partial necrosis of previous PMMC and LD was applied.

This patient had recurrent ca buccal mucosa where both DP and forehead flaps had already been used and so LD was chosen. LD flap necrosed completely on 2<sup>nd</sup> postoperative day. Patient was discharged for microvascular repair elsewhere.

### **Gastric transposition:**

All the 4 cases were for pharyngolaryngoesophagectomy.

1 case developed wound dehiscence and fistula.

1 case developed secondary haemorrhage and expired in the postoperative period

### **Pericranial flaps**

There were 2 anterior craniofacial resections – recurrent ca of right eye lid involving the skull base and another case of post RT residual nasal cavity TCC.

Both patients had closure of anterior skull base by use of dural and

pericranial flaps both healed well without complication.

### **Royapettah scoring system:**

A scoring system devised by our department to assess the postoperative outcome of our major oral resections incorporating both functional (chewing, speech, swallowing) and cosmetic aspects has been applied to all cases and the outcome assessed.

<b>Pain</b>	<b>Nil (5 )</b>	<b>Rare (3 )</b>	<b>modest (1)</b>	<b>Severe (0)</b>
Mouth opening	Normal	Trismus +	++	+++
Oral closure	Blows	Holds food	Rare spill	Drools saliva
Occlusion	Hard bite	Chews solids	Soft boiled	Liquids
Phonation	Normal	Few syllable difficult	Audible	Not audible
Swallowing	Normal	Avoids certain food	Rare regurgitation	Aspirates
Cosmetic/social acceptance	Resumes work enthusiastic	Adapts work satisfied	Socializes accepts	Confined dislikes

A score of 17 or more was considered satisfactory.

A total of 36 patients had satisfactory score.

14 patients had score of less than 17.

Most of our poor outcome were observed in the following situations.

- i) Preoperative poor mouth opening due to fibrosis (submucosal/RT induced)
- ii) Resections involving the oral commissure.
- iii) Mandibular resections involving the mentum.
- iv) Near total glossectomies
- v) Poorly nourished patients and inadequate support group.
- vi) Post RT
- VII) co morbid conditions.

**Scope for the future**

Apart from the definite need for microvascular flaps, our results could be improved by addressing the following problems:

- i) improving preoperative planning with the help of computerized planning and computer assisted choice of flaps by framing special software using the inputs of our previous experience.
- ii) adequate nutritional support to the patient in the form of parenteral nutrition /PEG etc.
- iii) Effective prosthodontic support like maxillary implants, obturators with dentures to be integrated in our preoperative planning.
- iv) Mandibular reconstruction in the form of alloplastic implants.
- v) Support team to take up rehabilitation of the patients after postoperative period.

## CONCLUSION

Head and neck cancer surgeries require various reconstruction methods ranging from the simplest to the complex. Reconstruction is to be tailored according to the needs of the individual case.

Pedicled regional flaps especially PMMC has been the workhorse in our hospital. Most of the complex oral and oropharyngeal resections can be effectively managed with PMMC without any expert plastic surgical help. They can be monitored easily postoperatively without any need for sophisticated methods as for free flaps. PMMC is the choice flap in high volume centres with resource and time constraints where microsurgical expertise is not available. They have proved effective in the absence of microvascular free flaps.

Further improvement in our results can be achieved if free flaps could be used in a choice few cases and effective mandibular reconstructions are to be used.



## BIBLIOGRAPHY

1. MARK D.DELACURE Head & Neck cancer II edition. Louis B. Harrison chapter 9 ;pp150-151
2. BYRON J. BAILEY M.D.Atlas of head & neck surgery otolaryngology 2<sup>nd</sup> edition; pp678
3. STEVEN H.SLOAN et al Cancer of the head & neck Eugene N.Myers 4<sup>th</sup> edition; chapter 28 ;pp635.
4. BARTON FE et al Head & neck reconstruction with LD myocutaneous flap anatomical observations and report of 60 cases; Plastic reconstructive surgery 71:199,1983
5. MAVES MD et al., Extended LD myocutaneous flap reconstruction of major head & neck defects- otolaryngologyhead & neck surgery 92:551 1984
6. BAKAMJIAN VY the detopectoral flap.plastic surgery of the head & neck.Newyork .Churchill Livingstone,1987;926.
7. A MILENOVIC et al the Pectoralis major flap in head & neck reconstruction; first 500 patients-Jnl of craniomaxillofacial surg.2006; Sep34 ( 6 )340-3
8. WADWONGTHAM W. et al., - The pectoralis major myocutaneous flap:applications and complications in head & neck reconstruction – J of medical asso Thai2004 Sep;87suppl 2;595-9

9. AHMAD OG et al- Bipaddle pectoralis major myocutaneous flap in reconstructing full thickness defects of cheek; a review of 47 cases –J Plas Recons Aesth Surg 2006;59(2);166-73
  
10. KOH KS et al – Pectoralis major musculocutaneous flap in oropharyngeal reconstruction: revisited.- plas ReconstrSurg2006 Oct;118(5);1145-9
  
11. CHATURVEDI P. et al – Simultaneous reconstruction of large skin and mucosal defects following head & neck surgery with a single paddle pectoralis major myocutaneous flap – J Laryngol Otol 2005 April 19 (4) 303 -5
  
12. FENG GM et al – Deltopectoral flap revisited : role of the extended flap in reconstruction of the head & neck - Scand.JPlast reconst surg 2006;40(5);275-80
  
13. FITSCHBERGER E et al – Flap reconstruction in mouth and oropharynx.A clinical comparison of methods – HNO 1981 Oct ;29(10)331-4
  
14. DESANTO LW – Tongue flaps:repair of oral and pharyngeal defects for cancer – Otolaryngol clinics of NA1983 may;16(2):343-51
  
15. OKURA M et al – Longterm outcome and factors influencing bridging plates for mandibular reconstruction. – oral oncol 2005sep;41(8);791-8
  
16. JJ COLEMAN et al – Reconstruction of the pharynx after resection for cancer.A comparison of methods. – ann Surg 1989 May;209 (5);554-561
  
17. JEAN PIERRE TRIBAULET MD – Surgical management of carcinoma of the hypopharynx and cervical esophagus analysis of 209 cases- Arch Sur

2001;136;1164-70

18. MARRIETTE C. et al Reconstruction after total circular pharyngolaryngectomy  
;comparison between gastric interposition and free jejunal flap – Arch Chir 2002  
Jun;127 (6);431-8
19. DE VRIES EJ et al Hypo pharyngeal reconstruction: a comparison of two  
alternatives. – Laryngoscope 1989 Jun; 99 (6pt 1);614-7